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E. W. HILGARD, Director.

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FIBER PLANTS FOR CALIFORNIA.

THE PRODUCTION OF RAMIE.

The revival of interest in the culture of ramie that has followed the announcement of the apparently successful tests, made of a new decorticating machine at the late Mechanics' Fair, renders it desirable to review some of the main points of this industry as bearing upon its adaptation to California. The great beauty of the fiber and the almost unlimited commercial demand for it when brought into the market in available form; its adaptation to a great variety of soils and climates, the high production, the perennial nature of the plant that renders its culture very inexpensive; last, but not least, the possibility of easily maintaining the productiveness of the soil by a return of the "trash," placing ramie near to cotton (when the seed is returned) as bearing very lightly on the soils' native fertility; and finally the relatively high value and light weight of the merchantable product when shipped—all these advantages concur in rendering the culture of this fiber plant specially desirable wherever it is feasible. That it has not become more widely spread, and has not largely superseded the much more costly and exhaustive culture of flax, is mainly due to the difficulty of accomplishing the separation and cleaning of the fiber by a machine sufficiently effective to compete with the scraping by cheap hand labor, which in the Orient is the habitual and the only mode of supplying to commerce the "China grass"* fiber.

This difficulty arises from the presence in the bark of a tough gummy substance that encases the fiber, and from which it must be thoroughly freed by either mechanical or chemical processes, or by both combined, before it can be worked.

Two essentially different plans have been pursued in the effort to accomplish this. One is the "wet" process, in which (as in the Orient) the green stalk is operated upon, requiring appliances somewhat distinct from those used in the preparation of hemp or flax fiber; while in the "dry" process, the mechanical operations are substantially the same in kind as the case of our familiar fiber plants, but modified to suit a specially difficult case. In either mode, the mechanical treatment has to be followed by a more or less intense chemical one, for the removal of the last remaining greenish gum from the silky fiber before the latter is ready for the spinning machine. The latter, in view of the great length of the ramie fiber, should be of the kind adapted for "line"

*The gross inappropriateness of the latter name may render it desirable to repeat here, for the benefit of those to whom the subject is new, that the ramie plant is a large, stingless, broad-leaved nettle, and therefore belongs to a family of plants of which many other members supply valuable fibers.

spinning; but of course it is quite feasible to convert the fiber into a tow or short-length material resembling long-staple cotton. Some of the older machines have done this; and if, as is now stated, such material can find purchasers among the workers in wool and cotton at remunerative prices, there is little difficulty about its production in large quantities. But one of the merits of the ramie fiber—its resemblance to silk—is thus grievously impaired, and it may be fairly said that no machine or process that does not produce the fiber in a condition for line-spinning can claim to have solved the problem of making ramie as profitable a crop as it can be.

The "wet" processes seem to have had the best success in the countries whose climatic conditions involve a perennially moist atmosphere, and where a thorough drying of the stems is therefore difficult. The principle upon which the work is done is, in general, the breaking of the more or less brittle and "brash" stems, fresh from the field and stripped of their leaves, by means of a suitable modification of the ordinary breaking process as applied to dry stems of hemp, etc. The stemless but undecorticated fiber, usually rolled into bands for the better preservation of its parallelism, is then dried, partially or wholly by artificial heat, so as to render the gum and bark brittle enough to be removed by subsequent beating and combing.

Sometimes this mechanical after-treatment has been omitted and the stemless crude fiber passed directly into the alkaline bath (mostly of common or of caustic soda), which is always required to remove the last of the gummy matter, but a too prolonged action of which will impair the strength of the fiber. The latter is then ready for a final combing and for spinning with or without preliminary bleaching.

The "dry" process differs from the "wet" in that the stalks, cut at the time when their oldest portion is just turning color from green to a brownish tint, are first allowed to dry in the field if this can be done, and when fully dry are at once subjected to the action of breaking, and of beating or combing machines that remove stalk and bark with gum in proportion to their perfection, leaving, again, the crude fiber more or less ready for the alkaline bath, as in the wet process.

It will readily be understood that the *dry* mode of working is best adapted to a dry climate, in which the stalks and gummy bark become so brittle that the breaking and beating is effective to a degree, which it would be impossible to attain in moist climates like those of Louisiana or Guatemala except by artificial heat, which, as stated, is therefore generally used in connection with the *wet* process. Hence the dry mode of working promises except onal advantages where, as in the interior of this State, the dryness of the summer air is proverbial. The dry process also possesses the advantage that each machine can be kept running continuously, on practically uniform material; while in the wet mode of treatment the plants must, in a large field, either be worked at very different degrees of maturity or else the crop must be attacked with a large number of machines, in order to secure uniformity of the product; after which the machines will lie idle. It would therefore seem, on the most general principles, that where the dry process is climatically feasible, it offers advantages over the other method, provided an equally good merchantable product can be turned out.

Without discussing the merits of the different machines now offered to producers as a guarantee that their crop when grown will be convertible into a merchantable article, and of which I personally am not at present fully informed, it should be said as regards the *culture* of ramie, that by actual trial it has been found to be readily feasible in all the larger valley regions of the State, so far as the successful growth of the plant is concerned, but that it will doubtless prove most profitable where a long growing-season, combined with irrigation, permits of making three or four cuts annually. In the Kern valley there is little difficulty in getting *four* cuts of good size and quality, and the same is probably true on the stronger soils as far north as Fresno, and southward in the valley of South California. In the Sacramento valley, *three* cuts can doubtless be obtained, at least when irrigation is employed, or in naturally moist land. At Berkeley and elsewhere on the immediate coast, *two* cuts (the second usually a small one) is all that can be counted on; but in warm valleys of the Coast Range doubtless from two to three full crops, according to the supply of moisture and the strength of the soil, may be looked for.

The following table shows the record of crops of the white-leaved ramie (*Urtica nivea*) harvested during four years on the Berkeley experimental grounds, the last of seven. No manure was used on the plot, but it was re-set in 1888 in order to equalize the stand which had been impaired by the distribution of roots; hence doubtless the low product in that year, and a later cut. The size of the plots of which the record is here given is 18x34 feet, or about one-forty-fifth of an acre. The green plants were weighed with the leaves, which are estimated at about one-half of the "live weight." The dry stalks were weighed practically leafless.

RESULTS OF EXPERIMENTAL CULTURE OF RAMIE ON THE UNIVERSITY GROUNDS, BERKELEY.

FIRST CROP.

Date of Cutting.	Plot.	Yield, lbs.	Yield per acre.	Percentage Dry to Green.
1887—June 24	1	576½ green	25835.7	
1888—July 16	1	491 green 135½ dry	22004.0 6072.4	27.6
1889	1	624 green 133 dry	28616.0 6095.2	21.3
1890—July 9	1	763 green 122 dry	34194.0 5471.	16.0
1890—July 9	2	623½ green 117 dry	27942.0 5283.1	18.8

SECOND CROP.

1887—Oct. 31		174 green	7797.8	
1890—Nov. 21	1	210 green 74 dry	9411.1 3312.7	35.2
1890—Nov. 21	2	210 green 74 dry	9411.1 3312.7	35.2

Assuming for the years during which the observations of the product were (on account

of frequent calls for samples) not as full as during the last, the same average ratio as to the weight of the two crops and the percentage of dry stalks yielded, we find that the product has been at an average rate of about 5700 pounds of dry stalks per acre for the first cut and about 3900 pounds for the second. This gross weight of course would be somewhat less in the dry air of the interior of the State; but the figures show that on strong soils the expectation of eighteen to twenty thousand pounds per acre, where four cuts can be made, is not extravagant. The minimum product from dry stalks is estimated to be 15 per cent of raw merchantable fiber. Upon these data an approximate estimate of the crop, and of its financial outcome in the several climatic regions of the State, may be based.

It is hardly necessary to remind any intelligent farmer that only *strong* soils can be expected to produce, in one season, a crop of ten tons of dry stalks of *any* kind, and that few can continue to produce such crops for many years without substantial returns to the land, no matter how fertile originally; but there is no reason why the offal of the ramie crop—the leaves and stalk-trash—should not be regularly returned to the soil. The leaves can be, and are usually, dealt with by stripping the stalk on the ground, leaving them where they grew. As to the stalks, it is true that with three or four cuts per season it will be difficult to deal with the large mass of refuse by spreading it on the stubble, although in the more northerly portions of the area of cultivation it may be desirable to use this material for protection against frost. But as the return must either be made, or fertilizers purchased, the proper mode of procedure will be to make compost-heaps of the trash and thus render it less bulky and convenient for spreading on the stubble after the last cut. This, in the case of strong soils, is all that will be required to keep up production for a long time, although the raw fiber sold represents a larger proportion of the soil's plant-food than in the case of cotton, in which the return of seed and stalk will maintain production indefinitely on any soil capable of yielding a profitable crop. When *no* returns are made, ramie will prove even a more exhaustive crop than is cotton when the seed is not returned, and those engaging in its culture had better understand from the outset that they can "rob the soil" with ramie even more effectually than with wheat.

On the strong, black, adobe soil of the Berkeley experimental plot, where purposely no return or fertilization of any kind has taken place, the crop of 1890 was fully as large as any previous one within the four years in which weighings have been made. Owing to the constant call for plants, the ground has never been solidly occupied by the crop; but even in the year in which the plot was reset in spring, with half the stocks, the product was nearly up to the average, so rapidly do the plants tiller and spread.

Among the strongest soils in the State are those containing more or less of "alkali," and as these are mostly valley lands, the question of their adaptation to ramie culture is important. Experiments have shown that while ramie is a little more sensitive to alkali than alfalfa, it will stand all but the strongest spots *provided the alkali is not of the "black" kind*, viz., carbonate of soda; and as the conversion of black alkali into "white" is easily effected by the use of proper doses of plaster or gypsum, it may fairly be said that with this proviso, ramie may be grown in alkali lands available for little else, since the growing of alfalfa cannot be carried beyond a limited point with profit to the producer on account of its relatively low value and heavy weight in transportation. The main reason why ramie will grow in alkali ground is the same as in the case of alfalfa—because it shades the ground, and hence the evaporation, going on through the leaves of the plants instead of at the surface of the soil, will not accumulate the noxious salts around the root crowns so as to corrode them. But it must not be forgotten that until the plants fully shade the ground, the rise of alkali in the *middles* must be prevented by thorough tillage, otherwise damage may result in that the outermost shoots suffer and the spread of the plants is retarded. As against alfalfa, ramie also possesses the advantage that, as it is not propagated from seed (in the field at least), but by the division and setting out of plants or their roots, the difficulty of obtaining a stand on account of the rotting of the seed by the alkali, does not exist.

So far, then, as the successful and profitable growth of the plant is concerned, there need be little doubt in the valleys of the central and southern parts of the State, so soon as the processes for marketing the fiber shall be an assured success.

E. W. Hilgard.

FLAX FOR SEED AND FIBER.

Occasional efforts have been made during the last 15 years to establish the manufacture of linen fabrics in California by those claiming to be practically acquainted with the industry elsewhere, but the projectors of such enterprises have abandoned the undertakings because of the alleged lack of interest among local capitalists. Whether this is the true reason for the failure to establish flax-spinning in this State or not, we do not pretend to state.

It has been frequently stated that the production of flax for both seed and fiber is not feasible, and our farmers who have grown flax for seed have therefore abandoned the thought, which has frequently arisen in their minds, of gaining something for their flax-straw as well as for the seed crop. It seems likely that an erroneous impression has thus been engendered, for there are recent authoritative statements to the effect that not only is the production of both seed and fiber from the same plant not impracticable, but that "by far the larger part of the flax grown the world over is for the double crop and double profit of both the seed and the fiber." * We are also assured that "it is possible to grow for both seed and fiber, though the fiber will be coarse, naturally, and only fit for the lower classes of manufacture."†

It is possible, then, that even in growing flax for seed, as now practiced in this country, the fiber could be made a source of income, providing the straw was not disintegrated as in the

*New York "Dry Goods Economist," Oct. 18, 1890.

†Report on Flax Hemp, etc., by C. R. Dodge, U. S. Dept. Agr., 1890.

prevailing mode of threshing. It is also possible that, by selecting a better variety of flax than commonly grown for seed, and by sowing more thickly so that the growth of lateral branches on the main stem is measurably repressed, there might be secured a fiber product vastly better than is now obtained and therefore fitted for a higher class of manufactures. This procedure might result in a lessened production of seed by the individual plant and perhaps a reduction in the aggregate yield per acre; in fact, in our experiments with flax varieties, we find that the best European fiber varieties yield much less seed than the variety commonly grown for seed in this State.

It may be concluded, then, that, though to grow flax both for seed and fiber requires closer thought and greater effort than is usually given to the flax crop, and that to make the straw available to manufacturers requires some investigation and investment on the part of the flax-grower, the current claim that one cannot grow flax for both seed and fiber is not necessarily true in the nature of the case nor in the experience of the greater number of the flax-growers of the world.

In order to minister to the oft-recurring demand from inventors for California-grown flax-straw for trial in their machines and processes, and to furnish seed to growers who desired to experiment, we secured from Europe, years ago, four of the best fiber-flax varieties and have grown them from year to year on the experiment grounds of the Berkeley station. They have attracted much attention from visitors for their beautiful, straight, tall growth of stem and bright, clear color. The growth of the four varieties has been quite similar, as shown by the record of 1890:

Variety.	Sown.	Germinated.	Bloomed.	Harvested.
Russian	Apr. 12	Apr. 23	June 5	July 24
Yellow-Seeded	Apr. 12	Apr. 23	June 2	July 24
White-Flowered	Apr. 12	Apr. 23	June 2	July 24
Royal	Apr. 12	Apr 23	June 5	July 24
California	Apr. 12	Apr. 23	June 10	Aug. 4

The European fiber varieties are thus shown to require a shorter growing period than the California-seed variety. The fiber varieties averaged one-third longer in straw than the California; they branched less and produced much less seed. Accurate weighings of straw and seed have not been secured hitherto because the plots were invaded from time to time to furnish specimens for exhibition and for experimental fiber extraction by local inventors. This year, careful weighings will be made.

Though these flaxes have aroused considerable interest here in the manner stated, there has been no result in local fiber treatment that is worth mentioning. Seed was sent to Washington Territory, and straw grown there was sent to European flax manipulators, who returned a very favorable report. On April 29, 1890, we received a circular request addressed by Mr. S. S. Boyce, President of the Boyce Fiber Company of New York, to the various experiment stations of the United States asking for samples of flax straw, which he agreed to work for fiber and report results. Mr. Boyce did not describe his process, but it is stated by Mr. Dodge (in his report to which allusion has been already made) to be "a process for cleaning flax without first submitting the straw to the process of retting, thereby obtaining the fiber at once." Such a process naturally would be more attractive to the flax-grower, for the time, labor and water required in retting are all probably of higher cost and more difficult to command in this State than in other regions where flax is grown.

The New York *Dry Goods Economist* of Oct. 18, 1890, contained a description of the working of the flax straw sent to Mr. Boyce from this station, with engravings of the several bundles as received by him. The following is a condensed tabular statement, which we compile from the data in the article referred to:

WEIGHTS OF SEED, STRAW AND FINE FIBER FROM CALIFORNIA-GROWN FLAX VARIETIES.

Variety.	Gross Weight.	Seed.	Straw.	Fine Fiber.
Yellow-Seeded	19	7	12	2¼
Russian	16	6	10	2⅛
Royal	15	6	9	2¼
White-Flowered	15	7	8	2
California	14	7	7	1½

Comments upon the experiments are, that the Russian and Royal seemed to be best, both for seed and fiber. The California gave much the largest yield of seed, and the seed was very large and plump, but the fiber was coarse and weak.

Of the general results of the experiment the *Economist* says:

There is no tow by this process of retting. The natural color of the straw was very light; that of the fiber almost perfectly white in each sample. The total yield of the fiber, 23 per cent of the weight of the straw, was rather a light yield of fiber but very fine. The yield of fiber is greater when the straw is not over-ripe. The samples treated had been allowed to get riper than required for either seed or fiber.

The results of this trial are of interest as showing clearly the superiority, from a textile point of view, of the flax varieties which this station has introduced to this coast over the common variety which is grown for seed. Whether it is possible to realize more by the attempt to produce both seed and fiber here, and to substitute one of these varieties for the one commonly grown, is an industrial question depending upon manufacturers and capitalists for solution. The farmer cannot afford to produce a crop of any kind until a market is assured.

E. J. WICKSON.

Berkeley, Jan. 23, 1891.